ALLOCATION REPORT

PREPARED FOR:

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY
2525 NORTH SHADELAND AVENUE
INDIANAPOLIS, INDIANA 46219

PREPARED BY:

TRIAD ENGINEERING INCORPORATED
325 EAST CHICAGO STREET
MILWAUKEE, WISCONSIN 53202

In association with

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TRIAD ENGINEERING INCORPORATED
PROJECT NO. I023557.BG005

SEPTEMBER 2003

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Section 1.0
INTRODUCTION/BACKGROUND

Watershed modeling is the quantitative component of a TMDL. The watershed model couples the landside and receiving stream models and is a quantitative tool for determining the response of a system to a causative factor, such as point or nonpoint source loadings and the subsequent instream concentrations. These quantitative modeling frameworks are useful tools for assessing the instream environmental effects due to point and nonpoint source discharges and also to assess the role of remedial programs aimed at correcting environmental pollution problems. The tasks associated with watershed modeling in Trail Creek include: the assessment of current conditions and estimating existing *E. Coli* bacteria from various sources (completed); reproducing existing or past watershed conditions through model calibration and validation (completed) and the determination of the Trail Creek watershed TMDL (this report). A map of the study area is presented in Figure 1.

A TMDL is the total pollutant load from point and nonpoint sources that a water body can assimilate while maintaining its designated use (water quality standards). It also includes an appropriate margin of safety and is expressed below:

$$TMDL = \sum WLA + \sum LA + MOS$$

where: WLA – Wasteload allocation for point sources;
LA – Load allocation for nonpoint sources; and
MOS – Margin of safety (implicit or explicit).

The focus of the TMDL is the reduction of pollutant inputs to a level (or "load") that fully supports the designated use of a given water body. The mechanisms (implementation plan) used to address water quality problems after the TMDL is developed can include a combination of BMPs and/or effluent limits and monitoring required through NPDES permits.

Section 2.0
TRAIL CREEK WATERSHED MODEL INTRODUCTION

The Trail Creek watershed model is based on two public domain models: a watershed model BasinSim 1.0 (GWLF), and a receiving water quality model WASP6. BasinSim 1.0 was used to compute time variable runoff quantity in the Trail Creek watershed due to factors such as rainfall, land use/cover and soil type. The WASP6 model was used to simulate water quality in the major branches in the watershed due to the watershed loadings, dilution and chemical/physical/biological reactions. This calibrated and validated modeling framework was used to calculate Trail Creek *E. Coli* levels due to the point and nonpoint allocations as part of the TMDL process.

Section 3.0
PROBLEM IDENTIFICATION

The year 2000 was used for watershed model calibration and will be used for determining the TMDL for *E. Coli* in Trail Creek (Triad, 2003). The hydrologic conditions observed near the mouth of the creek during the year 2000 were an annual rainfall of 29.92 inches, average event rainfall of 0.24 inches, maximum event rainfall 2.43 inches, and an adjusted average annual river flow of 58 cfs (range of 3-804 cfs). *E. Coli* bacteria levels in the years 1998-2001 and 2000 are presented in Table 1. These data indicate that all of Trail Creek violates the IDEM geometric mean *E. Coli* standard of 125 #/100mL and maximum daily standard of 235 #/100mL. Figures 2 and 3 present a summary of the *E. Coli* levels in the three branches of Trail Creek for the years 1998-2001 and 2000, respectively. These figures present the geometric mean of the *E. Coli* data $\pm$ 1 standard deviation at each of the monitoring stations in the main, west and east branches of Trail Creek. Figure 4 presents probability distributions of the *E. Coli* data and indicates that standards are violated 80-90% of the time. These figures highlight that the west branch of Trail Creek has higher *E. Coli* levels than the main and east branches, with the east branch having the lowest levels of the three branches. The upper reaches of the west branch have the highest *E. Coli* levels potentially due to cattle/steer operations in the area, agricultural drainage, failing septic systems, and/or illicit connections.

Table 1. *E. Coli* Levels (Geometric Mean #/100mL) in Trail Creek

Location	1998-2001	2000
Main Branch[1]	669	664
West Branch[2]	1790	942
East Branch[3]	446	524

[1] Stations 1 mile and above from mouth to avoid Lake Michigan influence (1.48M, 2.18M, 2.43M, 4.02M, 4.96M, 6.57M)

[2] Stations above Waterford Creek (2.24W, 2.44W, 2.72W, 3.65W, 3.71W, 4.72W)

[3] All stations including tributaries (2.45E-BC, 3.03E, 4.78E-SA, 4.43E-BD, 5.99E-BrD, 4.94E-BD, 6.46E-GD, 7.04E-BD)

Section 4.0
NUMERIC TARGETS

The Indiana Department of Environmental Management (IDEM) is required to establish a Total Maximum Daily Load (TMDL) generating process and implementation procedure that follows the federal guidelines and regulations. Waterbodies that do not meet established water quality standards must be identified and watersheds draining to the Great Lakes must also comply with the Great Lakes Initiative. Lake Michigan specific TMDL Guidelines have been established and Trail Creek has been identified through the 303(d) listing process as being impaired for the parameter of concern, *E. Coli*, which has a maximum daily standard of 235 #/100mL in any one sample in a 30-day period and 125 #/100mL as a geometric mean based on not less than 5 samples equally spaced over a 30-day period during the April to October recreational period.

Section 5.0
SOURCE ASSESSMENT

Potential *E. Coli* sources in the Trail Creek watershed originate from both point and nonpoint sources under both dry and wet weather conditions. There are seven permitted point sources in the watershed, which include the J. B Gifford Wastewater Treatment Plant (Michigan City), Friendly Acres Mobile Home Park, Autumn Creek Mobile Home Park and Indian Springs Subdivision. Michigan City does have two combined sewer overflows (CSO) points, but there were no reported events in 2000. In addition, CSO events in Michigan City have improved dramatically since 1990 (Table 2) and currently the city has implemented a *Long Term CSO Control Plan* (LTCP; April 24, 2002) that includes sewer separation to reduce combined sewers in the District's service areas. The LTCP has been reviewed by IDEM, and Michigan City is currently in the process of responding to their comments. These point source permits require that effluent disinfection occurs during the recreational season (April to October) and year 2000 DMR records indicate that each of these point sources are meeting their permit requirements. Therefore, point sources in the Trail Creek watershed are not considered a significant source of *E. Coli*.

Table 2. Michigan City Sanitary District CSO History

Year	Number of Annual CSO Overflows (Outfall 002)
1990	47
1991	24
1992	2
1993	32
1994	3
1995	0
1996	19
1997	14
1998	1
1999	0
2000	0
2001	1

Nonpoint sources in the watershed are varied and include: agricultural field drainage and runoff, cattle/steer grazing (both in fields and in the creek), failing septic systems, illicit connections and/or urban stormwater runoff. These nonpoint sources are a function of rainfall, land uses and soil type but also operate on a relatively continuous basis as exhibited by the observed consistent high levels of *E. Coli* throughout the watershed. These more continuous nonpoint sources may be due to cattle/steer grazing in the creek, failing septic systems in close proximity to the creek and/or direct illicit connections to the creek.

Linking these point and nonpoint source *E. Coli* loads was completed with the Trail Creek watershed model, which describes the *E. Coli* cause (loads) and effect (concentrations) relationships in the watershed. These cause and effect relationships occur during both dry and wet weather conditions. Development of the TMDL is defined

by continued control of point sources (IDEM permitting) and control of nonpoint sources through stormwater management plans, best management plans (BMPs) and local cooperation in controlling these sources with the assistance of State watershed grants.

Section 6.0
TMDL DEVELOPMENT AND ALLOCATIONS

A TMDL is the maximum loading of a pollutant that a waterbody can assimilate and still meet State water quality standards. The numeric targets for the Trail Creek *E. Coli* TMDL are a monthly geometric mean standard of 125 #/100mL and a maximum daily standard of 235 #/100mL. Typically, loading assessments are completed at critical waterbody conditions (e.g., point source WLA are typically completed at low-flow, summer conditions). Based on the source assessment and watershed modeling, *E. Coli* levels in Trail Creek are present during both dry and wet weather conditions and, therefore, low-flow critical conditions are not necessarily appropriate for developing the TMDL. The critical conditions for determining the *E. Coli* TMDL are varied and the year 2000 modeling period was used, which represents a range of both dry and wet weather conditions. In addition, seasonality must be incorporated into the TMDL and this is accomplished with the year 2000 modeling period, which ranges from January to December 2000 (winter, spring, summer and fall).

TMDLs for most pollutants are developed on a mass loading basis (e.g., BOD allocations to point and nonpoint sources in units of pounds/day). For *E. Coli*, a mass loading approach is not suitable and, therefore, a concentration based approach is used as recommended by the USEPA (USEPA, 2001). This concept is presented below as stated in the USEPA document *"Protocol for Developing Pathogen TMDLs"*.

> "For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For fecal indicators, however, TMDLs can be expressed in terms of organism counts (or resulting concentration), in accordance with 40 CFR 130.2(i): 'TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure,' and NPDES regulations at 40 CFR 122.45(f): 'All pollutants limited in permits shall have limitations … expressed in terms of mass except … pollutants which cannot appropriately be expressed by mass.' "

Therefore, the Trail Creek TMDL will be developed on a concentration basis so that *E. Coli* levels throughout the watershed will meet the State monthly geometric mean standard of 125 #/100mL and maximum daily standard of 235 #/100mL.

In order to meet the TMDL concentrations (125 and 235 #/100mL), continued operation of the four point sources in the watershed in accordance with their IDEM NPDES permits (125 #/100mL monthly geometric mean and 235 #/100mL daily maximum) at their permitted effluent flow will meet the WLA component of the *E. Coli* TMDL for Trail Creek. The permitted flow for the Michigan City Sanitary Station is 12 MGD, for Friendly Acres Mobile Home Park is 0.015 MGD, for Autumn Creek Mobile Home Park is 0.025 MGD, and for Indian Springs Subdivision is 0.025 MGD. Any violations of their permits and, therefore, violation of the TMDL will be handled through IDEM permitting groups and DMR reporting requirements. Typically, these point sources operate at *E. Coli* levels less than the TMDL concentrations and, therefore, will provide an additional level of protection. Continued efforts by the Michigan City Sanitary District to implement their LTCP will minimize and eventually eliminate CSO discharges of *E. Coli* to Trail Creek. The LTCP has been reviewed by IDEM, and Michigan City is currently in the process of responding to their comments.

Similarly, nonpoint sources in the watershed will need to meet the TMDL concentrations (125 and 235 #/100mL) in order for Trail Creek to be in compliance with State *E. Coli* standards. Since nonpoint source loads are rainfall runoff driven, an initial estimate of the nonpoint source LA component of the TMDL was assigned a runoff concentration of *E. Coli* at the maximum daily standard of 235 #/100mL. The base flow LA component of the nonpoint sources (i.e., the continuous loading component) was assigned an *E. Coli* concentration of 125 #/100mL. The resulting instream *E. Coli* concentrations due to the WLA and LA described above is presented in Figures 5a through d, which present the resulting *E. Coli* concentrations at the calibrations stations in the main, west and east branches of Trail Creek. As presented, the maximum daily *E. Coli* standard of 235 #/100mL is attained with these load allocations but the monthly geometric mean standard is still violated at a number of stations.

An additional LA was developed that assigned a nonpoint source runoff *E. Coli* concentration of 125 #/100mL. The resulting calculated instream *E. Coli* concentrations for this additional LA is presented in Figures 6a through d. The resulting TMDL for this additional LA results in attainment of both the daily maximum and monthly geometric mean standards in Trail Creek. This final TMDL requires an *E. Coli* nonpoint source LA of 125 #/100mL for all sources. Tables 3 and 4 present the final WLA and LA in counts/day that meet the TMDL concentrations of a monthly geometric mean of 125 #/100mL and daily maximum of 235 #/100mL during the recreational season of April to October. A summary of the total WLA and LA for the final TMDL is presented in Table 5.

The required MOS is incorporated into the TMDL analysis implicitly. TMDL rules allow for an explicit MOS (i.e., expressed in the TMDL as a portion of the allocations) or an implicit MOS (i.e., incorporated through conservative assumptions in the analysis). The implicit MOS was used because the die-off rate of *E. Coli* was assigned as zero for the allocation model calculations.

Table 3. Point Source *E. Coli* WLA (#/day)

Month	Mich. City Sanitary Station	Friendly Acres MHP	Autumn Creek MHP	Indian Springs Subdivision
Apr	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}
May	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}
Jun	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}
Jul	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}
Aug	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}
Sep	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}
Oct	5.68×10^{10}	7.10×10^{7}	1.18×10^{8}	1.18×10^{8}

Table 4. Nonpoint Source *E. Coli* LA (#/day)					
Month	**East Branch**	**West Branch**	**Main Branch**	**Baseflow**	**Total**
Apr	1.36×10^{10}	1.42×10^{10}	5.50×10^{10}	9.18×10^{10}	1.75×10^{11}
May	3.38×10^{8}	3.98×10^{8}	1.17×10^{10}	9.18×10^{10}	1.04×10^{11}
Jun	1.18×10^{11}	1.30×10^{11}	1.51×10^{11}	9.18×10^{10}	4.91×10^{11}
Jul	1.08×10^{10}	1.16×10^{10}	1.45×10^{10}	9.18×10^{10}	1.29×10^{11}
Aug	1.69×10^{5}	1.82×10^{5}	1.68×10^{7}	9.18×10^{10}	9.18×10^{10}
Sep	2.49×10^{9}	4.57×10^{9}	1.04×10^{10}	9.18×10^{10}	1.09×10^{11}
Oct	4.53×10^{3}	9.73×10^{3}	1.68×10^{10}	9.18×10^{10}	1.09×10^{11}

Table 5. Trail Creek TMDL *E. Coli* WLA & LA (#/day)			
Month	**Total WLA**	**Total LA**	**TMDL**
Apr	5.71×10^{10}	1.75×10^{11}	2.32×10^{11}
May	5.71×10^{10}	1.04×10^{11}	1.61×10^{11}
Jun	5.71×10^{10}	4.91×10^{11}	5.48×10^{11}
Jul	5.71×10^{10}	1.29×10^{11}	1.86×10^{11}
Aug	5.71×10^{10}	9.18×10^{10}	1.49×10^{11}
Sep	5.71×10^{10}	1.09×10^{11}	1.66×10^{11}
Oct	5.71×10^{10}	1.09×10^{11}	1.66×10^{11}

Section 7.0
MONITORING AND REASONABLE ASSURANCE

In order to investigate the effectiveness of the allocations in meeting the Trail Creek TMDL, continued monitoring in the watershed for *E. Coli* is recommended. The monitoring program should be designed to provide good spatial coverage of the watershed but also be aimed at obtaining data during dry and wet weather conditions. In addition, storm event monitoring should also be completed to better define nonpoint source loadings in the watershed.

For the permitted point sources in the watershed, IDEM NPDES permitting and monitoring requirements will provide the necessary reasonable assurance that these sources are not contributing to violations of State *E. Coli* standards. For the nonpoint sources, State stormwater regulations and land application permits should also provide these necessary reasonable assurance for these potential types of nonpoint sources. The other nonpoint sources will need to be monitored locally for implementation of BMPs or in providing access to watershed grants to assist in reducing nonpoint sources to meet the LA developed under this TMDL.

Section 8.0
REFERENCE

Triad Engineering Incorporated, 2003, Watershed and Water Quality Modeling/Analytical Report, September 2003.

USEPA, 2001. Protocol for Developing Pathogen TMDLs. United States Environmental Protection Agency, 841-R-00-002.